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Observations on the Migration of Monarch Butterflies through Evanston, Illinois in September, 1948

Orlando Park *

Although the widely distributed monarch butterfly, *Danaus menippe* (Hubner) [= *D. plexippus* Linné], is known to have migratory habits (Beall, G., *Ecology*, vol. 29, 1948, p. 80-94), there appear to be no circumstantial accounts of its movements through the Chicago Area.

While the current autumn migration of birds and butterflies was in progress the following quantitative study was made. The field of observation was a back yard, three blocks west of Lake Michigan, and extending one hundred feet in east-west length and fifty feet in north-south width. Observations were made primarily from a second floor rear porch, giving an unobstructed view, and facilitating the use of field glasses, stop-watch, and other equipment.

It must be emphasized that this is a local study, and involves only that portion of the monarch population that moved through the area cited above.

Population Size. It was noticed that the butterflies were coming through sparingly on September 5 and the idea of observing their migration led to hasty preparations. All of the monarchs passing through the yard were counted on September 7, between 10:00 A.M. and 6:00 P.M., Central Standard Time, and on September 8, between 8:30 A.M. and 3:00 P.M. It was found that this method, although giving the most accurate population data, was too great a task for one observer. Consequently, from September 9 through September 13 samples of the population were counted for fifteen minute periods widely distributed between 8:00 A.M. and 6:00 P.M. Nine such samples were taken on September 9, twelve on September 10, ten on September 11 and 12, and nine samples on September 13.

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The author is not a lepidopterist, but was tempted to make a temporary excursion from his research field by the abundance of material. He has yielded to this temptation in the present local study, and would welcome constructive criticism from any source on this report since plans are being made to duplicate this work with additional help should a similar occasion arise. Among other things, the marking of individual butterflies would seem to be essential.

A representative sample from the note-book is given for one day in Table I.

T A B L E I

Sample of Monarch Population Data for September 11, 1948

Observed Periods in Central Standard Time	Number of Butterflies per Period	Remarks
8:15 - 8:30 A.M.	16	Fair, 70° F. (shade)
8:45 - 9:00 "	11	"
9:45 - 10:00 "	14	" 76° F.
11:00 - 11:15 "	6	" 77° F. "
11:30 - 11:45 "	6	"
12:30 -] 2:45 P.M.	4	" 80° F.
1:30 - 1:45 "	3	" 82° F. "
2:45 - 3:00 "	2	" 84° F. "
3:45 - 4:00 "	3	" 84° F. "
5:45 - 6:00 "	0	" 76° F. "

The next step was to estimate the day's total number of butterflies passing through the observation area. This estimate was obtained as follows. First, hourly averages were obtained by multiplying the fifteen minute totals by four, or if more than one such period was observed for a given hour, these periods were first averaged and then the average multiplied by four. Second, the hourly averages were plotted on graph paper (Fig. 1). In this figure it will be seen that for a ten-hour day one or two hours were not represented; e. g., in the case of the example for September 11, there were no data for 10:00 to 11:00 A.M. and 4:00 to 5:00 P.M. These lacunae were filled by taking the estimate where the graph line crossed the hour line in question. Third, the total estimate for the day was obtained by adding the hourly estimates. Fourth, an average hourly migration for the day was obtained by dividing the day total estimate by the number of hours involved. This general method of estimating the monarch population is far from perfect but appeared to be the best solution under the circumstances. These estimates are given in Table II.

The total population estimate of 1,940 butterflies passing over the 5000 square feet of observation area between September 7 and 13, inclusive, is not accurate. No monarch was seen flying before 7:00 A.M. or after 6:00 P.M. That is, they appeared to travel during the day, as is to be expected in view of their diurnal behavior pattern. Consequently, since observations began on most days after 7:00 A.M., and on some days ceased before 6:00 P.M., a certain number of these insects were undoubtedly missed. To correct for this

error, the daily population curves were extrapolated, and the total estimate was added to by these amounts. This brought the corrected population estimate up to 2,407 monarchs passing through the yard in seven days. If the estimate is in error it errs very probably on the conservative side, but it is felt that this estimate is fairly accurate. Of the 1,940 insects estimated in Table II, before adding 464 by extrapolation, 684 were actually counted. In other words, of the Table II estimate, 35 per cent represented a counted fragment of the total.

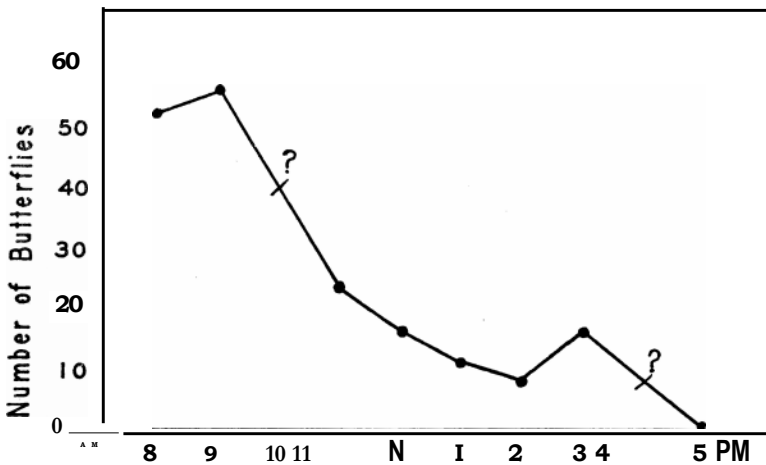


Fig. 1. A representative population curve for those monarch butterflies passing through the observation area on September 11, 1948. Hourly estimates are indicated as dots on the curve, and the two hourly intervals for which no data were available are estimated by taking the point at which they fall on the curve. These are indicated by question marks. The horizontal coordinate shows the hourly intervals by their initial time, for example, 8 A.M. means 8 to 9 A.M., inclusive.

Effects of the Operating Factor Complex. It has been estimated that a population of some 2,400 monarch butterflies passed through a yard 100 feet long in an east-west axis in seven days. Throughout this time the insects were moving generally in a southwest by south direction. Although regular observations had to be discontinued on September 13, the butterflies were noted coming through the area sparingly through September 24. These stragglers composed between ten to thirty individuals per day so that the overall migration is to be looked upon as a rather lengthy one, occupying some two to three weeks.

This aggregation appeared to be a loosely integrated assemblage. The only overt evidence of temporarily closer integration took place when a monarch settled on a flower already occupied by another. Frequently then both insects would rise and fly about each other for a few seconds in a complicated series of spirals, following which one or both would fly off.

T A B L E I I
Estimates of Monarch Population in Area Under Study

Number of Date	Samples September 15 min.	Limits of Observations C. S. T.	Hourly Average Estimate	Estimated Day Total	Remarks and shade temperatures
7	_____	10:00 A.M.- 6:00 P.M.	15	123	Fair
8		7:00 A.M.- 3:00 P.M.	-	27	Very overcast at 7 A.M., misting at 8 A.M., rain from 9 A.M. to 3 P.M. Temp. range 60° to 70° F. See text and Fig. 2.
9	9	8:30 A.M.- 6:00 P.M.	116	1162	Peak of migration. Fair all day. Temp. range 64° to 71° F. See text and Fig. 2.
10	12	9:00 A.M.- 5:30 P.M.	21	186	Fair all day. Temp. range 67° to 71° F.
11	10	8:15 A.M.- 6:00 P.M.	23	228	Fair all day. Temp. range 70° to 84° F.
12	10	8:45 A.M.- 5:30 P.M.	18	177	Fair all day. Temp. range 82° to 88° F.
13	9	6:30 A.M.- 2:45 P.M.	4	37	Fair all day. Temp. range 73° to 74° F.
Total estimated population:				1,940	

An attempt was made that is, records were kept with respect to the level at which the butterflies came into or over the area of observation. Three such levels were used: from ground to six feet (which, of course, included the flowers); from six to twenty-five feet; and a high zone of from twenty-five feet to seventy-five feet (measured against the crowns of two large cottonwood trees). The impression was gained that the monarchs flying through at higher levels spent less time over the area. This is probably true, since there would be (a) fewer obstructions to their flight from buildings and vegetation, and (b) fewer positive stimulations from flowers.

A second impression gained was that during the early period of the observed migration (September 7 through September 10) the insects spent less time on the flowers than later on. During this initial period those coming through at the low and medium levels stopped only at beds of phlox and false dragonhead. During the later period the decreasing number of butterflies visited these flowers and in addition spent much time on marigold, calendulas, goldenrod, roses and other blooming plants. In other words, the stragglers continued to straggle instead of catching up with the main body of insects.

This is an average picture. Almost all possible combinations were observed as far as individuals were concerned. Within the operating air temperatures of the period, at least four environmental factors can be noted: food, shelter, daylight, and rain.

Food, in the form of flower nectar, has been mentioned and individuals visited the flowers from as little a time as two seconds up to five minutes.

Shelter was provided by elm foliage. This sheltering was of two kinds: temporary recuperation, during any time of the day for from one to fifteen minutes, and over-night recuperation. On three occasions monarchs were seen to settle on an elm leaf some twenty-five feet from the ground between 5:45 and 6:30 P.M., Central Standard Time. They were gone by 7:00 A.M.

Food and short periods of recuperation along the line of migration probably account for part of the individual behavior of the insects, since some would be coming in to take rest or nourishment while others would be flying over the area level with the top of tall trees.

No monarchs were seen to be molested by birds.

Daylight appeared to have a profound influence upon the monarch migration. As noted earlier, none of these diurnal insects were seen flying before 7:00 A.M. or after sunset, about 6:30 P.M. This wholly diurnal activity was in striking contrast to the bird migration taking place at the same period, and probably is a factor in building up dense place aggregations of monarchs on trees.

Finally, rain appeared to stop the migration of monarchs as quickly as darkness. Fortunately, a series of circumstances made a check of this factor possible. September 7 was a clear day and the monarchs were coming in with increasing frequency. September 8 dawned with a heavy overcast, misting and drizzle began at 8:00 A.M., and rain followed steadily from 9:00 A.M. through the rest of the day until a slow drizzle at 2:30 P.M., which continued into dusk. In the overcast, between 7:00 and 8:00 A.M., ten monarchs came through; in the drizzle, between 8:00 and 9:00 A.M., thirteen monarchs came through; when rain began at 9:00 A.M. the butterflies disappeared and no more were seen that day, with two significant exceptions: (a) the hard rain

Migration Speed. Another aspect of this study was the estimation of the rate at which the monarchs were passing through the area under observation. First, a series of individuals was clocked by stop-watch over measured distances, and then these separate measurements were converted to a standard ten second period. The average of these ten second periods was used as a figure for uninterrupted flight. No trial was clocked while a breeze was evident, and all trials were taken while the *insects* were in the air. These data are given in Table III.

TABLE III
Free Flight of Individual Monarch Butterflies

Date September	Time C. S. T.	Air Temperature in shade. Degrees F.	Original Datum	Converted speed yards per 10 seconds
14	2:00 P.M.		25 yds. in 7 sec.	38
15	10:00 A.M.	72	10 " in 2.5 "	40
	10:15 "	72	10 " 2.5 "	40
	10:30 "	72	11 " in 4 "	28
	11:30 "	74	10 " in 4 "	25
	12:10 P.M.	79	11 " in 3.5 "	31
	12:11 "	79	11 " in 3.5 "	31
	1:05 "	81	17 " in 6 "	28
	3:30 "	83	13 " in 4 "	32
	3:35 "	83	11 " in 4 "	28
	3:40 "	82	11 " in 4 "	28
	4:20 "	82	11 " in 4 "	28
	4:45 "	80	11 in 5	22
16	12:30 "	86	12 " in 5 "	24
	1:25 "	86	10 " in 3.5 "	37
	1:45 "	87	16 " in 6.5 "	24
	2:00 "	87	25 " in 6 "	41
	2:08 "	87	17 in 6	28
17	10:00 A.M.	84	18 " in 4.5 "	40
	10:55 "	86	17 " in 5 "	34
	11:00 "	86	17 " in 5 "	34
	3:35 P.M.	86	12 in 4	30
	4:00 "	86	11 " in 3 "	37
18	10:30 A.M.	80	11 " in 4.5 "	24
	10:55 "	84	18 " in 5.5 "	33

Average time: 31.5 yards in 10 seconds.

From the data in Table III, the uninterrupted flight of migrating monarch butterflies is placed at an average of **31.5 yards in 10 seconds**. The slower rates cited were those of individuals that were usually leaving a flower,

and so included the initial period of getting under way. The medium rates cited were usually those that included some soaring in their flight time. The higher rates cited were usually those that were flying throughout the trial measured by stop-watch.

The average of 31.5 yards per 10 seconds works out at 6.4 miles per hour. This figure should not be considered as the speed at which the population migrates, since this would allow no time out for food and recuperation. On the observed behavior, furthermore, such an hypothesis is not tenable. A considered estimate of the time lost would be 50 per cent per day, so that the population speed would be at something like 3.2 miles per hour, or 32 miles for a ten hour day of perfect weather.

More or Less Unsupported Speculation. It is tempting to generalize from limited data. If the monarch population that passed through the observation area continued to bear southwest by south around the Chicago Area and then south to the Gulf Coast of the United States, it would be interesting to predict when the peak of this group would reach the end of such a particular journey. This speculation most unfortunately can not be checked, since at the time the present study was undertaken no plans had been made to attempt marking individuals.

Assuming that the September 9 peak moved only 25 miles per day, this would put them across the Ohio River about twelve days later, or September 20, and they should be on the Gulf Coast of the United States in thirty-two days from Evanston, or about October 10.